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A61F 2/46

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A5R RAT

(56) Documents Cited
US 5169399 A US 5098437 A

(58) Field of Search
UK CL (Edition O) A5R RAT
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ONLINE:WPI,CLAIMS

(54) Surgical tool for use in joint replacement

(57) The tool is designed to facilitate the insertion of a prosthetic acetabular cup of the type having "petals" extending from a "polar" region and comprises an elongate body having a plurality of legs 20 pivotally mounted at its distal end, each leg being pivotable radially with respect to the longitudinal axis of the body between inner and outer positions and having distal claws 36,37 for engaging a tip portion of a respective "petal", and means including winding handle 7 and threaded member 4 for effecting radial movement of the legs between said positions. In the intermediate position shown, the claws cause inward constriction of the "petals" to facilitate insertion of the cup into the prepared cavity, the claws subsequently being moved outwards (Fig. 3) to splay out the "petals" for engagement with the pelvic bone.

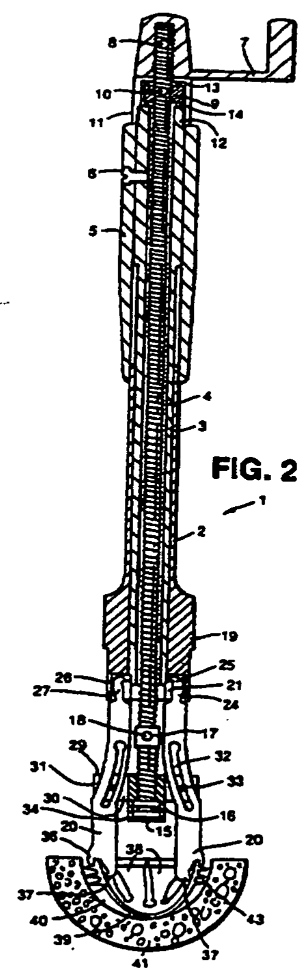

FIG. 2

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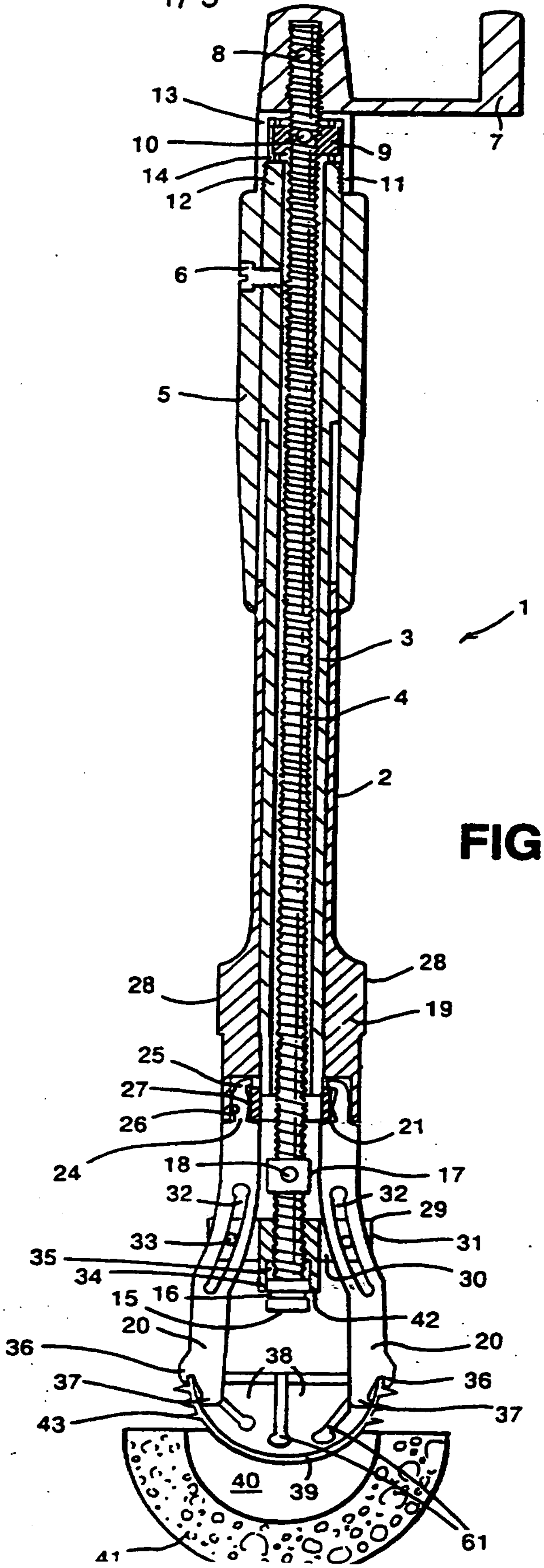
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FIG. 1

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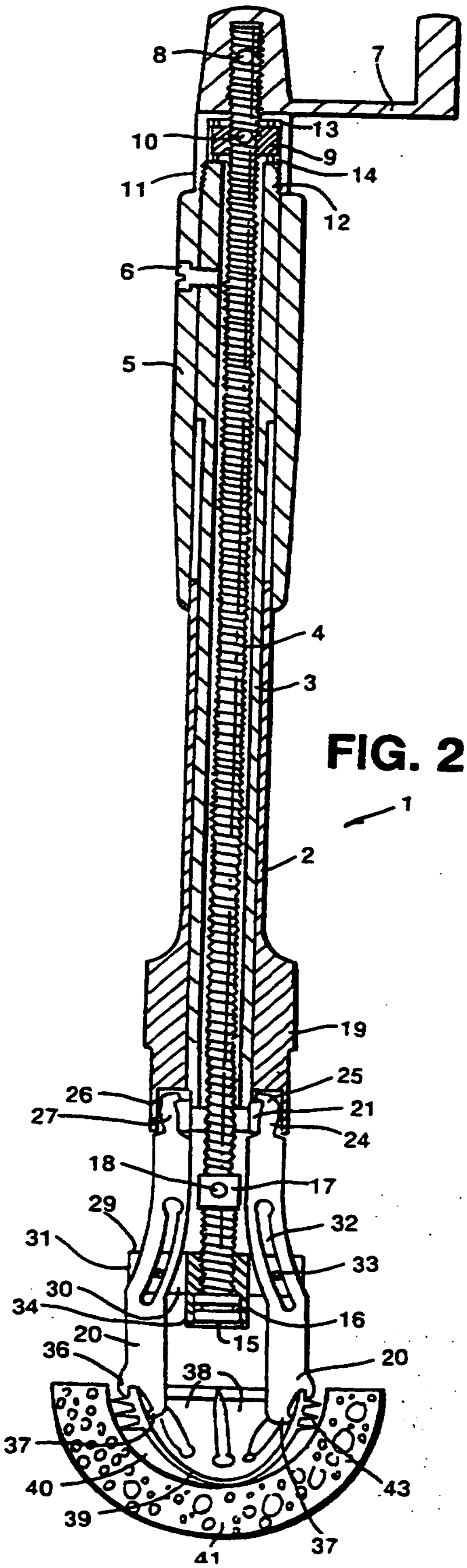

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FIG. 2

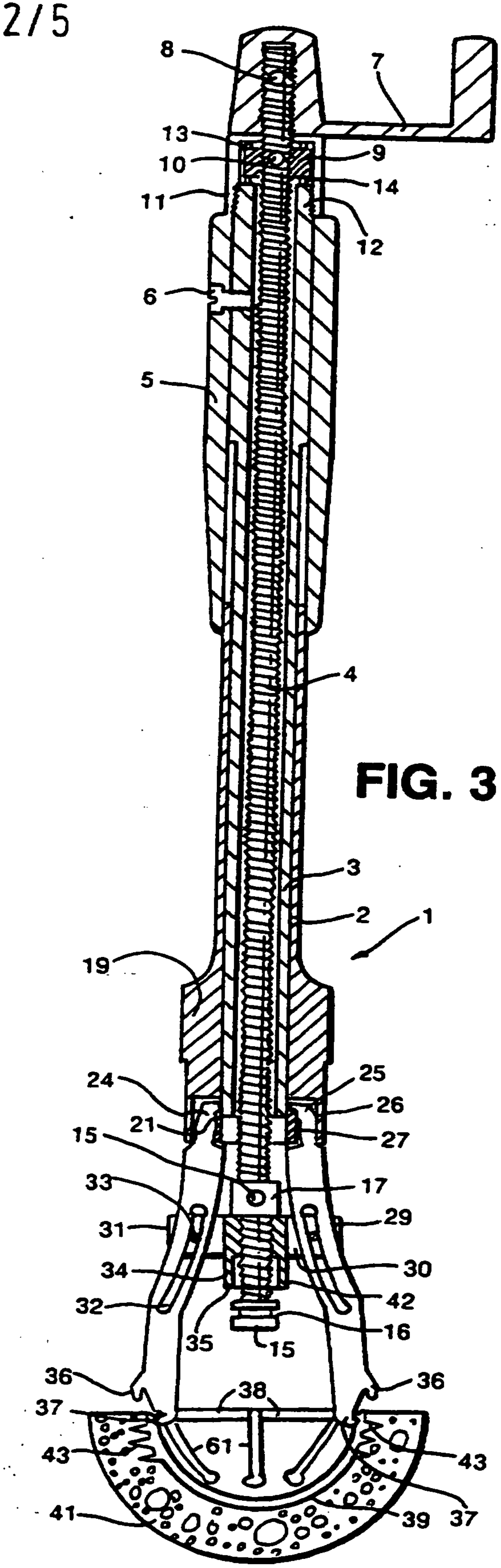

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FIG. 3

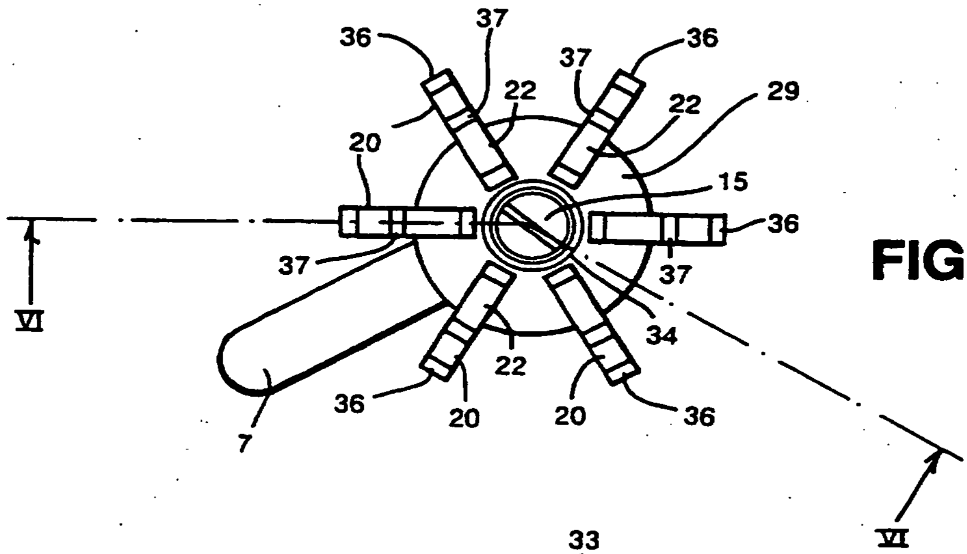

FIG. 4

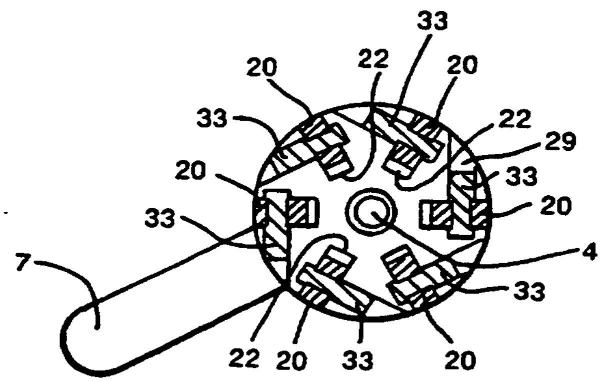

FIG. 5

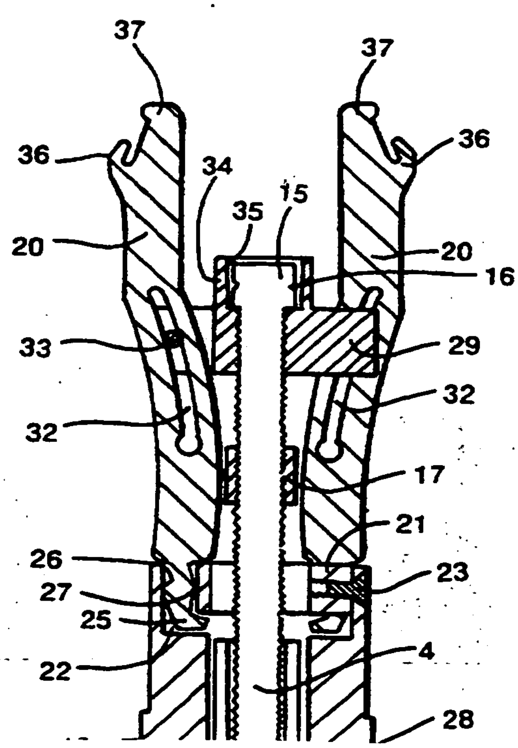

FIG. 6

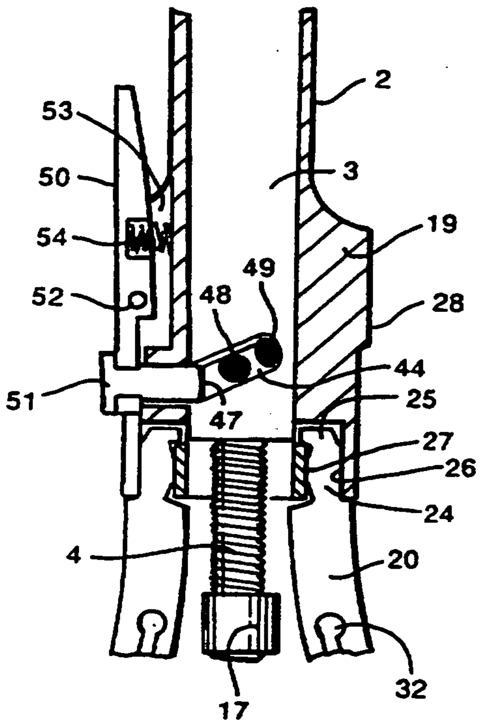

FIG. 7

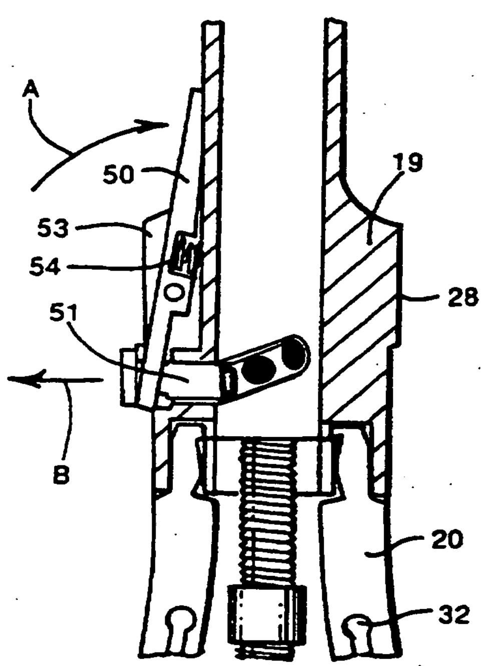

FIG. 8

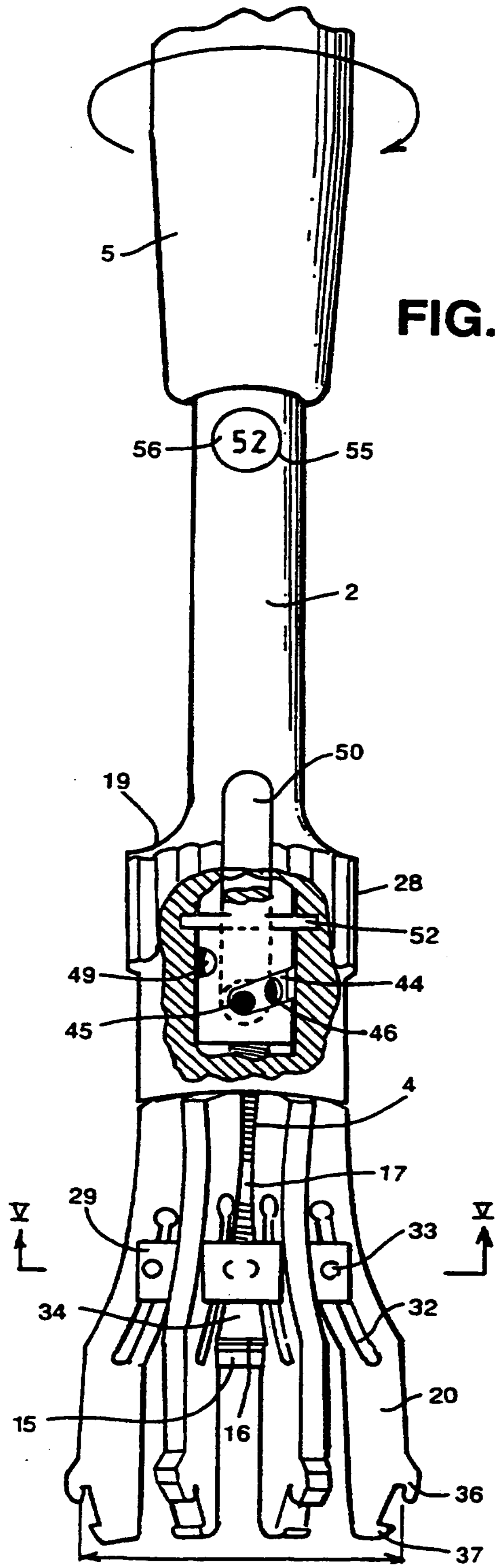

FIG. 9

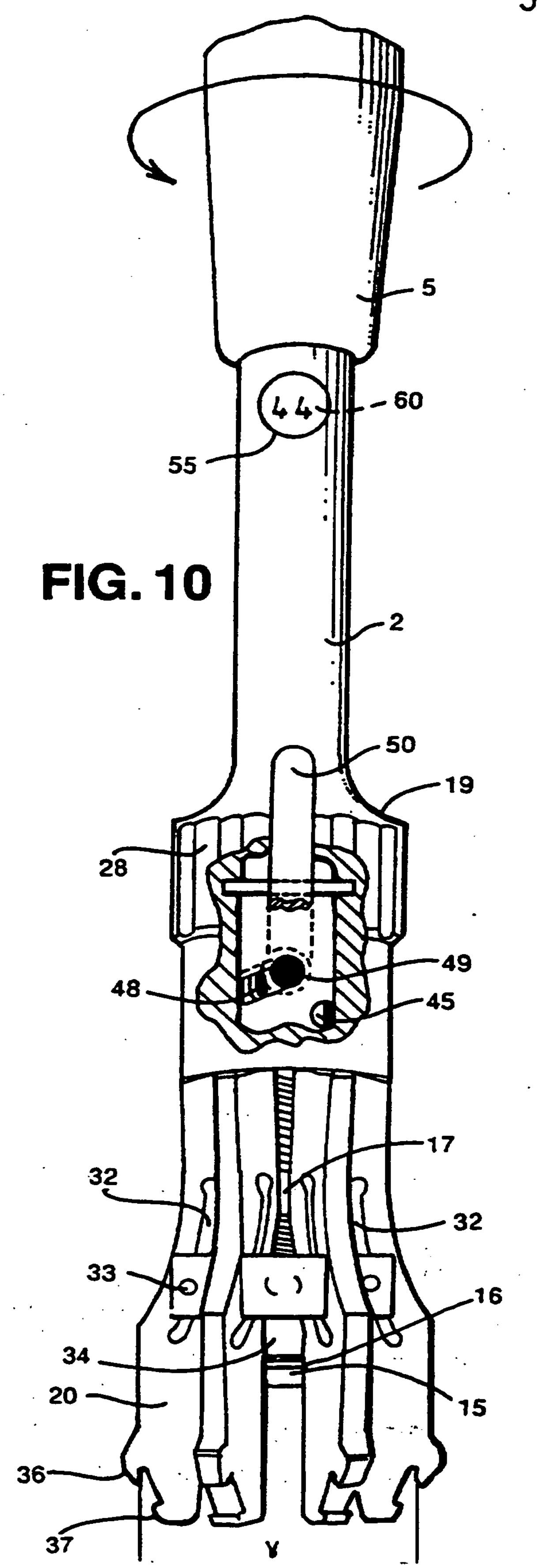
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FIG. 10

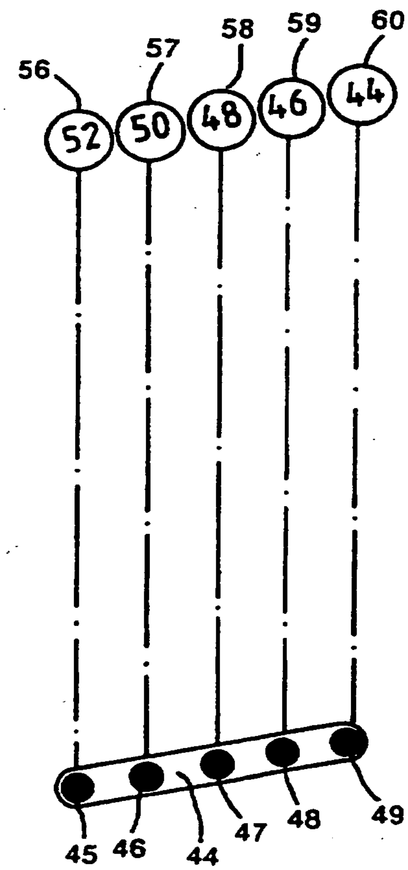
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FIG. 11

SURGICAL TOOL

The present invention relates to a surgical tool, more particularly to a surgical tool to assist the implantation of a prosthetic acetabular cup into a patient.

Acetabular cups are well known prosthetic devices which are used in the replacement of worn or damaged hip joints. To insert the artificial acetabulum, the surgeon will remove diseased bone, cartilage or other debris from the damaged acetabulum and then insert the acetabular cup into the prepared cavity in the patient's pelvic bone. Sometimes the artificial acetabulum is wholly made of a plastics material, such as ultra high molecular weight polyethylene (UHMPE). In this case the acetabulum is cemented in place with a layer of bone cement applied to the walls of the cavity before insertion of the cup. In other cases a two part acetabulum has been proposed, with a metal outer cup or sheath and a liner made from a plastics material, such as ultra high molecular weight polyethylene. The metal cup can be cemented in place before the liner is inserted. Accordingly the cup may be provided with external ribs which are intended to assist the bone cement to adhere to the cup surface. Alternatively the metal cup can rely upon cementless fixation. In this case the cup can have external ribs which extend helically so as to act as a screw thread; the surgeon applies torque to the cup during implantation to cause the cup to rotate through approximately a quarter of a turn and the ribs to bite into the bone. One or more bone screws can then be used to prevent the cup from rotating after implantation and so lock the cup firmly in place. Examples of prior art artificial acetabula are described in GB-A-2080118, GB-A-2126096 and EP-A-0065482.

A disadvantage of the one part type of acetabulum is that cement must be used to hold it in place after

implantation. Use of a cement is disadvantageous because it is a foreign material and can degrade under attack by the body's fluids.

An artificial acetabulum has been proposed which is comprised of two parts, i.e. (i) an outer metal sheath, typically made from titanium, a titanium alloy, or a cobalt-chromium alloy, having a polar region from which project a number of petals, typically six petals, which together with the polar region define a substantially hemispherical cavity and (ii) an inner hemispherical polyethylene cup which can then be inserted into the implanted metal sheath. A sheath for use in such an acetabulum is described in EP-A-0169978. However, even with the acetabulum of EP-A-0169978, insertion of the outer metal sheath is still an operation requiring considerable skill, dexterity and strength.

In a two-part acetabulum the polyethylene cup is usually formed with an external screw thread which mates with a corresponding internal screw thread on the metal sheath. Before the cup is inserted an expansion cone of metal is first screwed home into the sheath in order to expand the still constricted sheath to its proper diameter in the acetabular cavity. Then the cone is removed and the cup is screwed home. However, after removal of the cone, the sheath can spring back slightly. Thereupon when the cup proper is screwed home there is a danger that small shreds of polyethylene may be shaved off the cup and remain in the patient's hip joint as a potential cause of long term problems. In addition there is a danger that small fragments of metal can be formed as the cone is screwed home to expand the sheath. These metal fragments can damage the bearing surfaces and otherwise cause problems to the patient.

Because different patients may have different bone

structures, for example on account of their differing heights, weights, age and sex, a different size of artificial acetabulum may be needed for one patient from that required for another patient. Moreover, although a surgeon may plan to use a particular size of implant, in practice it may be necessary to use a different size from that planned. Hence the surgeon will have available for a particular hip replacement operation a range of sizes of acetabular implant. Conveniently the size is expressed in terms of the maximum outside diameter of the implant, typically measured at or adjacent its rim. Thus acetabular implants are typically available in diameters of 44 mm, 46 mm, 48 mm, 50 mm, 52 mm, 54 mm, 56 mm, 58mm, 60 mm, and 62 mm.

With a two-part acetabular implant the petals of the sheath should desirably be constricted uniformly in a reduction step to maintain the symmetry of the sheath as it is inserted. It is extremely difficult to achieve uniform constriction during the reduction step with conventional tools whilst maintaining the ability to apply the necessary force to insert the sheath into the acetabular cavity. Moreover it is usually necessary for the surgeon to have available not only a tool for use in the reduction step and for insertion of the constricted sheath into the acetabular cavity as well as for removing the sheath in readiness for re-implantation, or for insertion of a sheath of a different size, if the initial implantation should not be satisfactory in the surgeon's opinion, but also a completely separate tool and a set of expansion cones of different sizes, one for each size of sheath, for expanding the sheath to its proper size after its insertion into the acetabular cavity.

It is an object of the present invention to provide a tool for implanting an acetabular sheath of a two-part artificial acetabulum which substantially ameliorates the

aforesaid difficulties. It is a further object of the present invention to provide an improved from of surgical tool with which a surgeon performing a hip replacement operation can insert an acetabular sheath into the acetabular cavity of a patient. It is yet a further object of the present invention to provide such a tool which can be adjusted readily by a surgeon in the course of a hip joint operation to permit insertion of any one of a number of different sizes of acetabular sheath. It is a still further object of the present invention to provide a surgical tool which can be used not only for reduction and insertion of an acetabular sheath into a prepared cavity in a patient's pelvic bone and for removal therefrom in the event of the surgeon being dissatisfied with its placement therein, but also for expansion of the constricted sheath to its proper diameter in the patient's acetabular cavity. It is a still further object of the invention to provide a surgical tool which can be used not only for reduction and insertion but also for expansion of a range of different sizes of acetabular sheath with a simple adjustment mechanism for adjusting the tool to enable its use for each size of acetabular sheath within the range of sizes.

According to the present invention there is provided a surgical tool for implanting into a patient requiring a hip replacement a metallic acetabular sheath of the type having a polar region with a plurality of petals extending therefrom, the tool comprising an elongate body having a plurality of legs pivotally mounted at a distal end thereof, each leg being pivotable about a proximal end portion thereof radially with respect to the longitudinal axis of the elongate body between an inner position and an outer position and passing through an intermediate position, and each leg having on a distal end portion thereof petal engagement means for engagement with a tip portion of a

corresponding petal of an acetabular sheath, the petal engagement means on the legs together defining a substantially circular first locus, and leg movement means for effecting radial movement of the legs between their inner and outer positions, the petal engagement means on the legs being engageable with the petals of an acetabular sheath upon appropriate presentation of the sheath thereto with the legs in their intermediate positions, the petals on the acetabular sheath together defining a substantially circular second locus corresponding to the first locus, the petal engagement means causing inward constriction of each of the petals thereby to facilitate insertion of the acetabular sheath into a prepared cavity in the pelvic bone of the patient upon inward movement of the legs from their intermediate positions towards their inner positions in which the petal engagement means together define a substantially circular third locus of smaller diameter than the first locus, the petal engagement means causing outward expansion of each of the petals upon outward movement of the legs from their inner positions towards their outer positions in which the petal engagement means together define a substantially circular fourth locus of diameter larger than or substantially equal to the diameter of the first locus, thereby to cause the petals of the acetabular sheath, after placement thereof into a prepared cavity in the pelvic bone of the patient, to splay outwards and engage with the pelvic bone of the patient, and the petal engagement means being disengageable from the petals, after implantation of the acetabular sheath in the pelvic bone of the patient, upon movement of the legs back from their outer positions to their intermediate positions.

In the surgical tool of the invention the legs preferably each have an inward side facing the longitudinal axis of the tool and an outer side and the petal engagement

means comprise claws on the outer sides of the legs on distal portions thereof. Preferably the tip portion of each leg is provided on its outer side with a first claw defining a first undercut groove which faces generally towards the distal end of the leg and which is adapted to receive a tip portion of a corresponding petal of an acetabular sheath. The tip portion of each leg may further be provided on its outer side with a second claw defining a second undercut groove which faces generally towards the proximal end of the leg, the second claw being adapted to engage with an inner peripheral ridge on a petal of an acetabular sheath.

Typically there are six legs arranged so that their tip portions are equally spaced around the periphery of a circle. In this case the surgical tool can be used with an acetabular sheath having a like number of petals, i.e. six. However there may be fewer than six legs, e.g. four or five legs, if the sheath has fewer petals than six. Alternatively there may be more than six legs, e.g. 7, 8, 9 or 10 legs if the tool is to be used with sheaths with 7, 8, 9 or 10 petals respectively.

In one form of surgical tool according to the invention the leg movement means comprises a screw threaded member provided with an external screw thread rotatably mounted in the elongate body so as to be rotatable about the axis of the tool and a carriage operatively linked to the legs and threadedly engaged with the external screw thread on the screw threaded member. In this way the carriage can be moved longitudinally with respect to the body to cause radial inward or outward movement of the legs upon rotation of the screw threaded member relative to the body.

Preferably each leg is provided with a slot extending generally longitudinally of the leg and the carriage is operatively linked to the legs by means of transverse pins which run in the slots in the legs.

Longitudinal movement of the carriage relative to the body thus causes inward or outward splaying of the legs in dependence upon the direction of longitudinal movement of the carriage.

It will usually be beneficial for the slots to be curved.

To facilitate operation of the tool a winding handle can be connected to the screw threaded member at the proximal end of the body.

In one arrangement the screw threaded member carries a stop member at its distal end, to limit longitudinal movement of the carriage towards the distal end of the tool and to determine the inner positions of the legs, as well as carrying a collar to limit longitudinal movement of the carriage towards the proximal end of the tool and to determine the outer positions of the legs.

The carriage can be provided with a longitudinally extending recess to accommodate the stop member at least in part, and the stop member can be provided with a first indicium which only becomes visible when the stop member has at least partially emerged from the recess in the course of its longitudinal movement at a point corresponding to the intermediate positions of the legs. Conveniently the recess is formed in a distally facing tubular projection, in which case the first indicium may comprise an external peripheral groove on the stop member.

In one form of construction of surgical tool according to the invention the body comprises a generally tubular outer sleeve member having a first axial bore, in which a generally tubular main inner body member having a second axial bore is slidably received in the first axial bore. The legs are then pivotally mounted on a distal end portion of the outer sleeve member, while the screw threaded member is received in the second axial bore and is

journalled in the main inner body member in a fixed journal preventing axial displacement of the screw threaded member relative to the main inner body member. In addition this preferred form of tool further includes means for causing relative axial displacement of the outer sleeve member and the main inner body member to vary the distance between the proximal end portions of the legs and the fixed journal, thereby to vary the diameter of the first locus and hence the diameters of the third and fourth loci.

Conveniently the means for causing relative axial displacement of the outer sleeve member and the main inner body member comprises a captive pin mounted in the outer sleeve member, the radially inner end of the captive pin being slidably received in a helical groove in the outer surface of the main inner body member. This helical groove preferably extends over approximately one turn of a helix. The helical groove can be formed with a series of blind bores spaced along the length of the base of the groove; the radially inner end of the captive pin is receivable in any chosen one of the blind bores, and the captive pin is biassed radially inwards to lock the outer sleeve member in position relative to the main inner body member. To facilitate the aforesaid relative axial movement between the outer tubular sleeve and the main inner body member to provide adjustment for different sizes of acetabular sheath it is convenient to provide a manually operable catch member which is pivotally mounted on the outer sleeve member and to link the captive pin operatively to the catch member so that, upon actuation of the catch member, the captive pin is withdrawn from a first corresponding blind bore whereupon the outer sleeve member and the main inner body member can be twisted relative to one another to cause the radially inner end of the captive pin to move along the helical groove until it engages a selected second blind bore.

It is also proposed that the main inner body member should carry a tubular handle for manipulation by one hand and that the outer sleeve member should be formed with an enlarged section portion providing a hand grip portion for manipulation by the other hand.

It is also preferred that the main inner body member carries a series of second indicia each indicative of the diameter of a respective first locus corresponding to a given relative axial displacement of the outer sleeve member and the main inner body member, and that the outer sleeve member is provided with a corresponding window through which is visible a respective one of the second indicia corresponding to the actual relative displacement of the outer sleeve member and the inner main body member and hence to a respective first locus diameter. These second indicia can correspond to some or all of the commonly available sizes, e.g. 44 mm, 46 mm, 48 mm, 50 mm, 52 mm, 54 mm, 56 mm, 58mm, 60 mm, and 62 mm.

In order that the invention may be more easily understood and readily carried into effect, a preferred embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a simplified cross section of a surgical tool according to the invention, showing only two of the six legs, and of a metallic prosthetic acetabular sheath which is to be inserted into a prepared cavity in the pelvic bone of a patient;

Figure 2 shows a similar view to that of Figure 1, except that the sheath has been constricted for insertion into the prepared cavity;

Figure 3 shows a similar view to that of Figures 1 and 2 with the sheath securely embedded in the cavity;

Figure 4 is an end view of the tool;

Figure 5 is a cross section on the line V-V of

Figure 9;

Figure 6 is a cross section on the line VI-VI of Figure 4;

Figures 7 and 8 are views, partly in cross section, of part of the tool of Figures 1 to 6 but rotated through 90° from the position shown in Figures 1 to 3 about the longitudinal axis of the tool;

Figure 9 is a similar view to those of Figures 7 and 8 with the tool rotated by a further 90° about the longitudinal axis of the tool;

Figure 10 shows the tool of Figures 1 to 9 adjusted for use with an alternative size of acetabular sheath; and

Figure 11 is a developed view of the surface of part of a main inner body member of the tool of Figures 1 to 10.

Referring to Figures 1 to 3, the instrument 1 comprises a generally tubular elongate metal outer sleeve member 2, a generally tubular elongate metal inner main body member 3 which fits snugly within and is axially rotatable relative to the outer sleeve member 2 over a limited range of axial movement, and an elongate metal screw threaded member 4 which fits snugly within the smooth bore of the inner body member 3 and is axially rotatable relatively thereto. A tubular handle 5 made of plastics or of a composite material is secured to the main body member 3 by means of a securing screw 6.

A metal winding handle 7 is secured to one end of screw threaded member 4 by means of a pin 8. Member 4 also carries a collar 9 which is fixed to member 4 by means of pin 10. Collar 9 forms the inner part of a ball race, the outer part of which is formed by a retaining cap 11 which is screw-threadedly received upon a corresponding screw threaded spigot 12 formed at the end of main body member 3. Cap 11 is retained in place by means of a radial locking

screw (not shown). Reference numerals 13 and 14 indicate the balls of the ball race.

By means of this arrangement the screw threaded member 4 can be axially rotated relative to the main body member 3 by operation of the winding handle 7 without moving longitudinally with respect thereto.

At its opposite end screw threaded member 4 has a stop member 15 fixed thereto; conveniently this is formed as a separate piece with a threaded shank which is received in a corresponding blind bore in the end of the screw threaded member 4. This stop member 15 is formed with an external indicating groove 16. Member 4 also carries a collar 17 which is held in place by a retaining pin 18.

Outer sleeve member 2 has an enlarged end portion 19 in which are pivotally mounted six legs 20; these are retained in position by an inner annular member 21 formed with six slots 22 (see Figures 5 and 6) in its radially outer surface, each of which receives a corresponding leg 20. Annular member 21 is retained in place in the enlarged end portion 19 by means of screws 23.

It will be appreciated by those skilled in the art that, although tool 1 has six legs 20 and is designed for use with acetabular sheaths having six corresponding petals, only two of the legs are illustrated in each of Figures 1 to 3 for the sake of clarity. In actual fact two further legs would be visible in each of Figures 1 to 3 if all the legs 20 were to be drawn correctly.

Legs 20 are shaped at their proximal ends so that they can pivot radially with respect to the enlarged portion 19 of tubular sleeve member 2 (and hence to the longitudinal axis of the tool 1) whilst being retained in position by annular member 21. Thus each leg 20 has a reduced section portion 24 with a lug 25 at its extreme proximal end and is formed with arcuate surfaces 26 and 27 which permit limited

pivoting of the leg 20 radially with respect to the longitudinal axis of the tool 1. In this radial movement leg 20 moves in its slot 22 in annular member 21.

As can be seen from Figures 9 and 10 in particular, enlarged portion 19 carries a series of external ribs 28 to facilitate manipulation of the tool 1.

Pivotal movement of the legs 20 is caused by a carriage 29 which is formed with an internal screw thread that is threadedly engaged with screw threaded member 4. This carriage 29 has six slots 30 cut in its radially outer surface 31, in each of which is slidably fitted a corresponding leg 20. Each leg 20 has a curved slot 32 formed in it and a pin 33 spans each slot 30 and passes through the corresponding slot 32 in the leg 20. By turning winding handle 7 screw threaded member 4 is made to rotate about the axis of the tool 1, to move carriage 29 axially with respect thereto, and to cause pins 33 to move in slots 32 to pivot the legs 20 inwardly or outwardly, depending upon the direction of rotation of the winding handle 7.

Carriage 29 has a tubular extension 34 which is formed with a cup-like recess 35 into which stop member 15 can be received. The range of axial movement of the carriage 29 relative to the screw threaded member 4 is limited at one end of the range when stop member 15 is received fully within recess 35, as shown in Figure 2, and at the other end of the range of movement when carriage 29 abuts against collar 17, as shown in Figure 3.

Each of legs 20 is formed at its ends with a pair of claws 36 and 37 for gripping a corresponding petal 38 of a metal acetabular sheath 39 which is to be inserted into a prepared cavity 40 in a patient's pelvic bone 41. Sheath 39 is typically made of titanium, a titanium alloy, a cobalt-chromium alloy, or another physiologically well tolerated metal having sufficient resilience to permit

limited inward and outward splaying of its petals.

Figure 1 illustrates the tool 1 and the acetabular sheath 39 with the legs 20 in an intermediate position. This intermediate position is indicated to a surgeon using the tool by groove 16 on stop member 15 being just visible adjacent an end surface 42 of the tubular extension 34.

Figure 2 shows the tool 1 and the acetabular sheath 39 with the legs 20 in their inner positions and with the sheath 39 ready for insertion into the prepared cavity 40 in the patient's pelvic bone 41.

In Figure 3 the tool 1 is illustrated with the legs 20 in their outer positions, after they have forced the petals 38 to splay outwards and force barbs 43 on the acetabular sheath 39 to dig into the bone 41.

Figure 7 illustrates part of the tool 1 with a portion of the outer sleeve member 2 cut away. Inner main body member 3 has a helical groove 44 cut in its outer surface, in the bottom of which are sunk a series of regularly spaced shallow blind bores 45 to 49 (see also Figure 11). A catch member 50 bearing a captive pin 51 is pivotally mounted on a pin 52 in a longitudinal groove 53 formed in the outer surface of enlarged portion 19 of outer sleeve member 2. A compression spring 54 urges captive pin 51 inwardly towards inner main body member 3. Upon pivotal movement of catch member 50 (as illustrated by arrow A in Figure 8), which causes captive pin 52 to move outwardly (as indicated by arrow B in Figure 8), against the force exerted by compression spring 54, the tip of captive pin 51 can run in the bottom of spiral groove 44. Catch member 50 is positioned so that it can be readily operated, by a surgeon holding the tool 1 by its handle 5 in one hand, with the thumb of the other hand. When the captive pin 51 is withdrawn as indicated in Figure 8, the outer tubular sleeve member 2 can be rotated relative to the handle 5 about the

axis of the tool 1, and hence relative to the inner main body member 3. In undergoing such relative rotation the tip of captive pin 51 rides up or down spiral groove 44. Upon release of the catch member 50, the tip of captive pin 51 can engage in a corresponding one of the blind bores 45 to 49.

Each of blind bores 45 to 49 corresponds to a setting for a particular size of acetabular sheath 39. Normally the size of the acetabular sheath 39 is defined in terms of its rim diameter. Typical sizes are 44 mm, 46 mm, 48 mm, 50 mm and 52 mm. Each of blind bores 45 to 49 corresponds to one of these sizes. A window 55 is cut in outer tubular sleeve member 2 (see Figures 9 and 10) through which is visible a corresponding size indicium 56 to 60. Since captive pin 51 is engaged in blind bore 45 in Figure 9, the indicium 56 visible in window 55 reads in this case "52" while the corresponding span x is 52 mm. On the other hand, when the tip of captive pin 51 is received in blind bore 49, as shown in Figure 10, the corresponding span y between claws 36 on each pair of diametrically opposed legs 20 is 44 mm and the indicium 60 visible in window 55 reads "44".

The effect of causing rotation of the outer tubular sleeve member 2 relative to the inner main body member 3, by engaging the tip of captive pin 51 in turn in the various blind bores 45 to 49, is to vary the axial distance between the collar 9 and the pivotal surfaces 26, 27 at the roots of the legs 20. It also has the effect of varying the axial distance between the pivotal surfaces 26, 27 and the carriage 29. Thus, as the carriage 29 is brought nearer to the roots of the legs 20 by this relative rotation, pins 33 also move towards the roots of legs 20 and cause the legs 20 to splay radially outwards somewhat. (It should be noted that this occurs without handle 7 being rotated relative to

tool 1). On the other hand, movement of the carriage 29, without rotating handle 7, away from the roots or proximal ends of the legs 20 by twisting the tubular sleeve member 2 relative to the main inner body member 3, causes the pins 33 to move along slots 32 towards the tips or distal ends of the legs 20. In this way the tips of the legs 20 are drawn inwardly somewhat.

Reference numeral 61 indicates radial slots between adjacent petals 38 of the acetabular sheath 39 (see Figures 1 to 3).

To use the tool 1, the surgeon first selects an appropriate size setting for the particular acetabular sheath 39 to be inserted by operating catch member 50 and twisting enlarged section 19 of outer tubular member 2 relative to handle 5. When the tool is correctly set, the selected size is indicated by the appropriate one of the indicia 56 to 60 appearing in window 55. The surgeon then rotates winding handle 7 until groove 16 on stop member 15 is just visible below end surface 42 so as to move legs 20 to their respective intermediate positions in readiness for presentation of an acetabular sheath 39 of the appropriate size thereto. The surgeon can then present acetabular cup 39 to the distal ends of the legs 20 such that a tip portion of a corresponding appropriate petal is received by the undercut grooves defined by claws 36. Figure 1 shows the tool 1 with an acetabular sheath 39, as supplied by the manufacturer, received in place on the distal ends of legs 20 with the claws 36 in engagement with the tip portions of the corresponding petals 38. (It will be appreciated that, although Figure 1 shows four petals 38, but for the sake of clarity only two legs 20, in practice each petal 38 would be engaged with a corresponding leg 20). Then the surgeon winds handle 7 anti-clockwise until stop 15 abuts against radial carriage 29 thereby preventing further movement of

the carriage 29 and legs 20 axially of the tool 1. This results in the legs 20 moving to their radially inner positions as shown in Figure 2 and in the petals 38 being constricted. As this happens radial slots 61 are forced to narrow. The distance thereby travelled by claws 36 corresponds exactly to the possible extent of constriction of the petals 38 of acetabular sheath 39. It also corresponds to the distance needed to draw the tips of the barbs 43 inwards to slightly less than the nominal size of the acetabular sheath 39 as supplied.

Referring to Figure 3, as the carriage 29 moves away from stop member 15 towards the proximal ends of the legs 20, thereby forcing legs 20 apart by the action of pins 33 in slots 32, the petals 38 of the acetabular sheath 39 are splayed outwards by claws 37. Hence, if the sheath 39 is positioned by the surgeon in the patient's acetabulum and the tool 1 is appropriately manipulated, then as the carriage 29 reaches stop member 15, the barbs 43 on sheath 39 become embedded in the bone 41 surrounding cavity 40. Exertion of the force required to cause claws 37 to splay the petals 38 outwardly causes the surgeon to withdraw the tool 1 marginally as indicated by comparison of Figures 2 and 3. This withdrawal ensures that the claws 36 are not trapped between the sheath 39 and the surrounding bone 41. After implantation of the sheath 39, a procedure which does not require the use either of bone cement or of any bone screws, the surgeon can release the tool 1 from the implanted sheath 39 simply by winding handle 7 in an anti-clockwise direction to move legs 20 back towards their intermediate positions as shown in Figure 1. This causes disengagement of the claws 37 from the tips of the petals 38 and the tool 1 can then be withdrawn.

If the surgeon is dissatisfied with the initial placement of the acetabular sheath 39, then he can offer up

the claws 36 to the implanted sheath 39 again and force claws 36 between the tips of the petals 38 and the bone 41. Upon then winding handle 7 to cause the legs 20 to move radially outwardly again, claws 36 can be made to constrict the petals 38 on acetabular sheath 39 sufficiently to enable the sheath 39 to be extracted from the cavity 40 by pulling lengthwise of the tool 1. The surgeon, with the tool 1 and sheath 39 now in a condition similar to that illustrated in Figure 2, can then reposition the sheath 39 in the bone 41 and embed it in position by winding handle 7 to cause the petals 38 to expand to the positions of Figure 3 again.

If the sheath 39 is of a size and shape such that the tips of its petals 38 still project slightly from the surface of the bone 41 after implantation, then this facilitates removal by the surgeon for repositioning or for replacement thereof in a subsequent surgical operation.

If the surgeon finds that he has initially chosen an acetabular sheath 39 of the wrong size, then it requires only a simple manipulation of the catch member 50 and relative rotation of the handle 5 and the outer tubular member 2 to adjust the spacing of the tips of the legs 20 to accept an acetabular sheath 39 of a different size.

It will be appreciated by those skilled in the art that the tool 1 can be used to reduce for insertion, to expand after insertion, and to remove for repositioning or replacement, any one of five different sizes of acetabular sheath 39. A second tool can be constructed according to the principles of the invention for use with the other five common sizes of acetabular sheath, i.e. 54 mm, 56 mm, 58 mm, 60 mm, and 62 mm.

Since the tool 1 incorporates fixed stops, in the shape of collar 17 and stop member 15, to limit axial displacement of the carriage 29, over-reduction and over-expansion of a sheath 39 is prevented, whatever its

nominal size, provided that it is one of the five sizes for which the tool 1 is designed.

Because the legs 20 push directly upon the petals of a sheath 39 during expansion thereof, the production of debris is prevented, while the danger of damaging the sheath 39 during implantation is obviated. After the sheath 39 has been inserted in the patient's acetabulum to the satisfaction of the surgeon an inner liner (not shown) of ultra high molecular weight polyethylene which is of a size to be a snug fit within the sheath 39 can be snapped in place in the implanted sheath 39. This liner can have an external groove which cooperates with the lip 62 to hold the liner in place. The liner, once inserted, helps to lock the entire artificial acetabulum in place without the need to use any bone screws or cement. Since the surgeon anchors the sheath 39 firmly in the patient's bone 41 during the course of the hip replacement operation, there is no requirement for the patient to wait for the bone to grow back before the joint regains its full strength.

CLAIMS:

1. A surgical tool for implanting into a patient requiring a hip replacement a metallic acetabular sheath of the type having a polar region with a plurality of petals extending therefrom, the tool comprising an elongate body having a plurality of legs pivotally mounted at a distal end thereof, each leg being pivotable about a proximal end portion thereof radially with respect to the longitudinal axis of the elongate body between an inner position and an outer position and passing through an intermediate position, and each leg having on a distal end portion thereof petal engagement means for engagement with a tip portion of a corresponding petal of an acetabular sheath, the petal engagement means on the legs together defining a substantially circular first locus, and leg movement means for effecting radial movement of the legs between their inner and outer positions, the petal engagement means on the legs being engageable with the petals of an acetabular sheath upon appropriate presentation of the sheath thereto with the legs in their intermediate positions, the petals on the acetabular sheath together defining a substantially circular second locus corresponding to the first locus, the petal engagement means causing inward constriction of each of the petals thereby to facilitate insertion of the acetabular sheath into a prepared cavity in the pelvic bone of the patient upon inward movement of the legs from their intermediate positions towards their inner positions in which the petal engagement means together define a substantially circular third locus of smaller diameter than the first locus, the petal engagement means causing outward expansion of each of the petals upon outward movement of the legs from their inner positions towards their outer positions in which the petal engagement means together

define a substantially circular fourth locus of diameter larger than or substantially equal to the diameter of the first locus, thereby to cause the petals of the acetabular sheath, after placement thereof into a prepared cavity in the pelvic bone of the patient, to splay outwards and engage with the pelvic bone of the patient, and the petal engagement means being disengageable from the petals, after implantation of the acetabular sheath in the pelvic bone of the patient, upon movement of the legs back from their outer positions to their intermediate positions.

2. A surgical tool according to claim 1, in which the legs each have an inward side facing the longitudinal axis of the tool and an outer side and in which the petal engagement means comprise claws on the outer sides of the legs on distal portions thereof.

3. A surgical tool according to claim 2, in which the tip portion of each leg is provided on its outer side with a first claw defining a first undercut groove which faces generally towards the distal end of the leg and which is adapted to receive a tip portion of a corresponding petal of an acetabular sheath.

4. A surgical tool according to claim 3, in which the tip portion of each leg is further provided on its outer side with a second claw defining a second undercut groove which faces generally towards the proximal end of the leg, the second claw being adapted to engage with an inner peripheral ridge on a petal of an acetabular sheath.

5. A surgical tool according to any one of claims 1 to 4, in which there are six legs arranged so that their tip portions are equally spaced around the periphery of a

circle.

6. A surgical tool according to any one of claims 1 to 5, in which the leg movement means comprises a screw threaded member provided with an external screw thread rotatably mounted in the elongate body so as to be rotatable about the axis of the tool and a carriage operatively linked to the legs and threadedly engaged with the external screw thread on the screw threaded member so as to move longitudinally with respect to the body to cause radial inward or outward movement of the legs upon rotation of the screw threaded member relative to the body.

7. A surgical tool according to claim 6, in which each leg is provided with a slot extending generally longitudinally of the leg and in which the carriage is operatively linked to the legs by means of transverse pins which run in the slots in the legs, whereby longitudinal movement of the carriage relative to the body causes inward or outward splaying of the legs in dependence upon the direction of longitudinal movement of the carriage.

8. A surgical tool according to claim 7, in which the slots are curved.

9. A surgical tool according to any one of claims 6 to 8, in which a winding handle is connected to the screw threaded member at the proximal end of the body.

10. A surgical tool according to any one of claims 6 to 9, in which the screw threaded member carries a stop member at its distal end to limit longitudinal movement of the carriage towards the distal end of the tool and to determine the inner positions of the legs and a collar to limit

longitudinal movement of the carriage towards the proximal end of the tool and to determine the outer positions of the legs.

11. A surgical tool according to claim 10, in which the carriage is provided with a longitudinally extending recess to accommodate the stop member at least in part, and in which the stop member is provided with a first indicium which only becomes visible when the stop member has at least partially emerged from the recess in the course of its longitudinal movement at a point corresponding to the intermediate positions of the legs.

12. A surgical tool according to claim 10, in which the recess is formed in a distally facing tubular projection and in which the first indicium comprises an external peripheral groove on the stop member.

13. A surgical tool according to any one of claims 5 to 12, in which the body comprises a generally tubular outer sleeve member having a first axial bore, in which a generally tubular main inner body member having a second axial bore is slidably received in the first axial bore, in which the legs are pivotally mounted on a distal end portion of the outer sleeve member, in which the screw threaded member is received in the second axial bore and is journalled in the main inner body member in a fixed journal preventing axial displacement of the screw threaded member relative to the main inner body member, and in which the tool further includes means for causing relative axial displacement of the outer sleeve member and the main inner body member to vary the distance between the proximal end portions of the legs and the fixed journal, thereby to vary the diameter of the first locus and hence the diameters of

the third and fourth loci.

14. A surgical tool according to claim 13, in which the means for causing relative axial displacement of the outer sleeve member and the main inner body member comprises a captive pin mounted in the outer sleeve member, the radially inner end of the captive pin being slidably received in a helical groove in the outer surface of the main inner body member.

15. A surgical tool according to claim 14, in which the helical groove extends over approximately one turn of a helix.

16. A surgical tool according to claim 13 or claim 14, in which the helical groove is formed with a series of blind bores in the base of the groove, in which the radially inner end of the captive pin is receivable in any chosen one of the blind bores, and in which the captive pin is biassed radially inwards to lock the outer sleeve member in position relative to the main inner body member.

17. A surgical tool according to claim 16, in which a manually operable catch member is pivotally mounted on the outer sleeve member and in which the captive pin is operatively linked to the catch member so that, upon operation of the catch member, the captive pin is withdrawn from a first corresponding blind bore whereupon the outer sleeve member and the main inner body member can be twisted relative to one another to cause the radially inner end of the captive pin to move along the helical groove until it engages a selected second blind bore.

18. A surgical tool according to any one of claims 13

to 17, in which the main inner body member carries a tubular handle for manipulation by one hand and in which the outer sleeve member is formed with an enlarged section portion providing a hand grip portion for manipulation by the other hand.

19. A surgical tool according to any one of claims 13 to 18, in which the main inner body member carries a series of second indicia each indicative of the diameter of a respective first locus corresponding to a given relative axial displacement of the outer sleeve member and the main inner body member, and in which the outer sleeve member is provided with a corresponding window through which is visible a respective one of the second indicia corresponding to the actual relative displacement of the outer sleeve member and the inner main body member and hence to a respective first locus diameter.

The Patent Office

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A5R (RAT)

Int Cl (Ed.6): A61F 2/46

Other: Online:WPI,CLAIMS

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	US 5169399	(Ryland et al.) see col.1 1.45 - col.2 1.20 and the Figures	1
A	US 5098437	(Kashuba et al.) see col.3 1.22 - col.4 1.38	1

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